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Education Planning Evolution for Forest Engineering in Spain

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Abstract

Forest engineering in Spain has a long tradition and active presence in the engineering field. It is also one of the first educational institutions that shaped the Spanish technological panorama in the mid nineteenth century. The actual situation of the forest systems in Spain is the result of 166 years of observation, research, education and the application of specific techniques and principles that forest engineers acquired with the successive study plans that were implanted in educational institutions. In this paper, the planning historical process of education in Forest engineer is analyzed, differentiating between four historical periods. The analysis of the stages focuses on the contents of the study plans, the orientation towards educational objectives, the duration of the studies and the causes for the modifications that had an impact on the evolution through time within the framework of the acquired experience and the technological advances.

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1. Introduction

The Spanish laws called *desamortizadoras* of the nineteenth century led to serious economic, social and environmental consequences for forests wealth, among which we can highlight: a strong breakdown of traditional use systems and a drastic change of land uses due to an irrational practice of plowing and deforestations of hundreds of thousands of hectares of forest area. The consequences of these policies reached such magnitude that the surface of the mountains inventoried around 1850s, of about 10 million hectares, more than half were alienated, leaving the State without the capacity to create its own and rational forest policy because of the lacking of land on which to

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apply the policies. Adding to this was the deplorable state that heritage forests presented from the point of view of production and conservation, as a result of inadequate management. Martin de los Heros, precursor of the Spanish forestry and Minister of the Interior in the Cabinet chaired by Mendizabal, writes about the forest situation in those years (1841-1842) saying that: *"The state of backwardness compared to other countries, of the forests and gardens of His Majesty convinced me of the need to give a scientific direction to increase its beauty and products".* (Garcia-Escudero, 1948).

Because of this situation, at the time arises among intellectuals and educated classes, the spirit of reconciling economic development with the natural balance, looking for forestry production of goods and services within the limits imposed by nature. The need to seek the replacement of atavistic routine methods in the growing and harvesting of trees also arose, for those the experience and the application of natural science proved most appropriate.

By the 30 April 1835 Royal Decree (RD), the Forests Corps were created. A day later, on May 1, another RD created the Special School of Forest Engineers, but political and economic upheavals of the time delayed their entry into operation. By RD, the 18 November 1846 the School of Forestry was established "as a means of promoting the cultivation and conservation of forests and plantations".

2. Methodology

The methodology of the research integrates two complementary bases of information: on the one hand, a source composed of the information already generated by tracking curricula, publications of the agencies responsible for the formation of the Body of Forest Engineers, scientific documentation; documents from libraries and legal texts consultation which served to establish temporal sequences. On the other hand, a very valuable resource was a primary information base formed by the empirical knowledge of the experience and perception of some of the actors and planners of the teachings at Forestry Engineering, editors of this work. This approach has also enabled achieving the following objectives: (a) making knowledge and experience of those involved the main source of information for Education program; (b) encourage the learning of the main actors (Cazorla et al, 2010); (c) focus changes from the beneficiaries of the Higher Education actions (designing, developing, implementing and evaluating) in Graduate and Postgraduate educational levels (De los Rios et al, 2010).

For justifying the historical stages, three additional criteria have been considered: (1) events or milestones, (2) the change of objectives and orientation of the studies regarding the training process, and (3) duration of the teachings. The information on the curricula was obtained from official sources of education agencies and the Royal Decree (RD) that defined the teachings.

3. Results

3.1. First stage (1847-1899): practical training based on naturalism

On August 18, 1847 the Organic Regulations of the School are published, and it received the final name of Special School of Forestry Engineering, and the first curriculum of the degree is established. The studies lasted for four years and the subjects were distributed as follows:

Table 1. First Curriculum (1847)

First Year	***Second Year***	***Third Year***	***Fourth Year***
-Elements of Algebra and Geometry Applied Forestry practices. -Elements of Linear Drawing and Landscape.	-Topography. -Plant System Linne -Drawing - Notions of Descriptive Geometry. -Practical Exercises.	-General Elements of geognosy. -Anatomy And Plant Physiology. -Entomology And Forest Zoology. -Practical Exercises.	Cut, crop and land use Treaty Plant Pathology Forestry law Forestry Notions Construction Practical Exercises

The school was opened in Villaviciosa on January 2, 1848, under the motto "to know is to do" that already guides

the practical nature that permanently endow the formation of its graduates.

The first curriculum synthesizes scientific and academic thinking of its founders, which is naturalism. The natural sciences provide the scientific basis for establishing the principles and techniques of forest management. The significant workload devoted to practical work clearly entails that direct observation, experimentation and the direct application of knowledge in the field should prevail over hypotheses and theories without experimental base and reality observation. The first major change to the Study Plan conducted through RD on the 20 October 1858, consisted only on modifying entry conditions.

Through the RD of May 18, 1862 a new regulation of the School so the studies got extended to reach the level of other Spanish and foreign schools was approved. The curriculum was still structured in four years and new subjects were included within the field of civil engineering and the study of more naturalistic subjects, with the inclusion of special subjects such as Forestry and Land Organization.

The increased number of subjects, without considering the increased number of courses, provoked a strong protest that called to distribute current studies in at least five years. The prestigious professor of botany Maximum Laguna wrote: *"If you have to study all subjects it is necessary for them to be distributed in five years because you cannot expect a young person to leave the school and with little practice, be a good botanist or forester" (Laguna,* 1866).

In 1870, the teachings of the 3 Special Schools of Engineers get reorganized and the Regulation of the School of Forestry that reduced the number of subjects and the duration of the degree to 3 years was published. All subjects of the curriculum were all strictly related to Forest Science. In 1880 there was a restructuring of the previous curriculum in which a preparatory course and all the subjects of the previous plan were distributed in four years.

In 1886 an important thing happened that substantially modified the learning processes of all engineering schools; by the RD of January 9, 1886, the General Preparatory School of Engineers and Architects was created, and it was common to all engineering where for three years the subjects became the common core subjects of engineering, for later continue the studies in the respective Special Schools. In the School of Forestry, the new 1887 Curriculum consisted of the same subjects of the 1880 one and distributed in a transitional course and 3 more courses. The RD of November 19, 1894 promulgated a new regulation which turned back to have an entrance exam at the Centre. The duration of the lessons went from 4 to 5 years including a preparatory course, leaving the subjects of the previous plan almost in the same situation.

The nineteenth century ends with this situation. The most eminent forest academics of this century advocated that the core of the teaching of Forest Engineering should be Forestry, Forest Management, Forest Products Industry and Climate Science. The other disciplines based on the natural sciences and those physical-chemical and mathematical should be regarded as ancillary teachings *"The main purpose of Forest Engineers is not Surveying, Geodesy, nor Mechanical nor Building. They are auxiliaries, but you can never say that they seek to be surveyors, mechanics or constructors" (Castellarnau,* 1885).

In the year 1885, because an immediate reform of teaching, the first disagreement about whether the training of Forestry Engineers should be more naturalistic or more technological arose. Most of the most significant engineers were positioned in favor of naturalistic training as JM Castellarnau in his opinions always insisted that the mistake in which he fell was in seeking similarities with other schools. *"What we would like is that education is School creates naturalists, not because we believe that exact natural sciences are better or worse, but because we believe they are the best for Forest Engineers" (Castellarnau,* 1885)

3.2. Second stage (1900-1944): towards a more productivist approach

With the arrival of the new century, forest teachings faced a new review. A new regulation RD on the 23 September 1902 is published, which states *"The new reorganization of the teaching should be geared towards improving and enhancing national forest wealth, incorporating modern advances in science and applying technical studies"* (Exhibition RD 1902). This regulation had a more productivist character than previous ones. In the next stage the duration of the studies is set to 6 years. Final degree internships disappear, which together with too much teaching materials created a more theoretical than practical profile. The Director of the School J.Munoz said *"The result is unnecessarily overloaded teaching that produces theoretical engineers instead of technical "(Munoz,* 1902).

The RD of 24 August 1910 reorganized teachings again. The duration of the degree is still six years and highlights the inclusion of technical contents related to Civil and Industrial Engineering, which guide the training towards technology.

In 1915 an RD provides access to free education students, which once graduated could only practice in companies of the sector. The Curriculum maintained a virtually identical training content. The RD of the 18 September 1920 states that the studies must have a duration of 5 years. Through RD of February 25, 1921 a new curriculum which advocates harmonizing the principles of forest science with new implants trends give teaching an increasingly practical side. This curriculum is the one with the most technological character to this date.

3.3. Third stage (1945-1999): a technology specialist training

On October 12, 1945 the University City of Madrid was inaugurated, as well as the new School of Forestry, where it sits today. The new Curriculum 1948 is updated with the reality of the country, which after the Civil War and World War II begins to have a visible social, technological and economic development. With the new political regime, the services of forest bodies acquire a strong impulse and development. At the same time the processing industry of forest products and construction began a major boost, providing a strong demand for graduates who begin to develop their career in the private and industrial sector. The significant increase of subjects makes it necessary to increase the duration of the degree to 5 ½ years in order to give more teachings and do the final project.

The Law of the 20 July 1957 on the Management of Technical Education conducted a thorough restructuring in the organization of forest teachings. The entrance examination which had been in place for the last 100 years was deleted in schools. A major innovation that occurred was the emergence of the specialties within the degree, with a clear differentiation between the educational content. The specialties of Forestry, Forest Industries and Holdings remained, with slight nominal changes over time.

The great reform initiated along the Law of July 20, 1957 ends with Law 2/1964 of April 29 on the Reorganization of Technical Education. Law 2/1964 of April 29, established for the first time free access to the upper forest teachings after passing the pre-university course. Besides, the specialties that had set the previous standard were maintained.

Curricula resulting from the significant reforms promoted by the 2 Laws were: Curriculum 1964 (B) of Forestry Engineers organized studies in 6 academic courses with the 2 specialties. The training content *silvopastoralism* specialty remained the classic degree with slight modifications. It is within the *industry* specialty where a great innovation occurs by including technological character subjects such as Thermodynamics, Thermal Engineering, Electrical Engineering, Industrial Technology, Electronics and Control Systems, Wood chemistry, technology of cellulose, among other. The Curriculum called Plan 1964-a (74) remained in force until the end of the century with few modifications.

3.4. Stage (since 2000): forest engineering in the EHEA

At the end of the Twentieth Century, in 1999 the Bologna Declaration is created in order to produce common European Higher Education. This phase is inserted into a full process of adaptation of the university to EHEA, consequent with the challenge of converting the European Union into a society based on more competitive and dynamic knowledge. This demands new international models (Guerrero et al, 2013) of educational innovation based

on competences and aptitudes; it implies new course designs and new learning objectives, affecting both teaching-learning methodologies and evaluation (De los Rios et al, 2011).

In 2003, Spanish universities who taught Forest Engineering studies got integrated into a working group to conduct the studies and analysis needed to develop a White Paper on Degrees on Agricultural Engineering and Forestry Engineering, as an essential element for the design of the Curriculum of the Official Degrees adapted to European standards.

For the first time the design of forest qualifications and their training content were the result of proper planning and working methods that involved all stakeholders (Universities, Professional, Industrial and Productive Sectors, etc). The result regarding the qualifications within the scope of cyclic education was a Bachelor's degree on Forestry and Natural Environment Engineering and a Master's Degree in Forestry Engineering after passing the Degree.

Regarding the training content of the degree in Forestry and Natural Environment, classical subjects which are the core of forest science have been preserved, but at the same time subjects linked with environmental technologies according to current environmental requirements were also included.

In the year 2010-2011 the new Degree was implemented in different Spanish universities, and in most cases the name adopted was bachelor on Forest Engineering. The first graduates of this great transformation ended last July. Master studies in Forest Sciences are in the process of being implemented.

Table 2. Synopsis of the historical development of the teachings of forest engineering

STAGE	CURRICULUM	YEARS	TITLE	ORIENTATION OF STUDIES	MILESTONES OF THE STAGE
1st Stage (1847-1899)	P.E. 1847 (I.M)	4	I.M.P.	Scientific management based on naturalism.	Creating of the School of IM (1848).
	P.E. 1858 (I.M)	4	I.M.		Creation of the protocols IM (1853).
	P.E. 1862 (I.M)	4			Creating of the School of Engineers and Architects (1886).
	P.E. 1870 (I.M)	3			
	P.E. 1880 (I.M)	5			
	P.E. 1887 (I.M)	4			
	P.E. 1894 (I.M)	5			
2nd Stage (1900-1944)	P.E. 1902 (I.M)	6	I.M.	Improving Forest wealth with a focus on production without sacrificing the naturalism	Creation of the body on AFM (1903).
	P.E. 1910 (I.M)	6			Adscripcion of the School or the Directorate in the Ministry of Education (1932).
	P.E. 1915 (I.M)	6			Creation of the School of Forest Engineers (1943).
	P.E. 1920 (I.M)	5			
3rd Stage (1945-1999)	P.E. 1948 (I.M)	5.5	I.M.	Integrated approach to the social, technological and economic development	Opening of the School of IM in Madrid (1945).
	P.E. 1957 (I.M)	5	I.M.		Creation of the School of Forestry Experts Madrid (1957).
	P.E. 1964 (I.M)	6	I.M.		Law on management of technical education (1957).
	P.E. 1964 (74) (I.M)	6	I.M.		Law on the reorganization of technical education (1964).
					Organic Law of University Reform (LRU) (1983).
4th Stage (desde 2000)	P.E. 2010 (I.F)	4	G.I.F.	Sustainable forest management, environmental management and conservation of forest systems, transformation of forest products. (Under the E.E.E. S.).	Organic Law of Universities (LOU) (2001).
					Implementation of the European Higher Education Area (EHEA) (2001).

P.E =Curriculo**; I.M.P**= Forest and Land Engineer; **I.M**= Forest Engineer; **G.I.F**= Bachelor on forest engineer

4. Conclusions

The teachings of Forest Engineering in Spain have had since the mid-nineteenth century to the present, an active and dynamic process, sensitive to economic, political and technological changes, as well as subject to constant revision and adaptation in response to these changes. They have evolved from a simple, practical, scientific basis in natural and life science to complex programs, increasingly specialized and technological, with a balance between theoretical, practical and targeted content, promoting employability, competitiveness and global acceptance.

In a first step these teachings were characterized by a strong naturalistic orientation attributable to the scientific thought of the first academics. It was naturalism based on the application of science to the management of forest systems and is identified by the presence of materials of this profile as well as the practical character of the studies.

In a second stage, due to the economic requirements of the country and to the academic influence over other technical engineering education, the teachings, maintaining the naturalistic conception, acquired a productivist character to include more technological content.

The third stage is characterized by its integrated approach towards social, technical and economic development, with a boost of technological content that reached its maximum exponent with the creation of the specialties approach.

In the fourth and final stage, forest teachings were structured so as to be comparable at European level and to promote employability. They have kept their specific content and have incorporated subjects related to environmental technologies in order to respond to current environmental requirements.

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